WILL SMALL BUSINESS BECOME THE NATION'S LEADING EMPLOYER OF GRADUATES WITH BACHELOR'S DEGREES IN SCIENCE AND ENGINEERING?

Most recipients of bachelor's degrees in science and engineering (S&E) enter the workforce full time after graduation: 72 percent of 1993 and 1994 bachelor's degree recipients held full-time jobs in 1995.[1] Two-thirds of these jobs were in U.S. industry, with small businesses—those with fewer than 500 employees—employing as many of these new S&E graduates as larger firms. The remaining one-third of S&E bachelor's degree recipients were employed by educational institutions, government, and the nonprofit sector.

Comparable proportions of science baccalaureate recipients and engineering baccalaureate recipients entered small business jobs—34 and 35 percent, respectively. Engineering graduates, however, were much more likely than science graduates to work for medium-sized to large firms[2] (50 percent versus 31 percent); they were less likely to work for nonprofit or educational institutions (figure 1). Employment sector differences are also apparent by degree field. For example, computer science and mathematics majors were more likely to work for larger firms than small (46 versus 30 percent); those with degrees in the social, life, or physical sciences were more likely to work in small firms (table 1).

WHAT ROLE DOES SMALL BUSINESS PLAY IN S&E JOB CREATION?

Several studies have highlighted the important role of small business in job creation (Johnson and Packer 1987); as the employer of 53 percent of the Nation's private workforce (Oberlender 1996); and the source of about half the country's private gross domestic product (SBA 1997).

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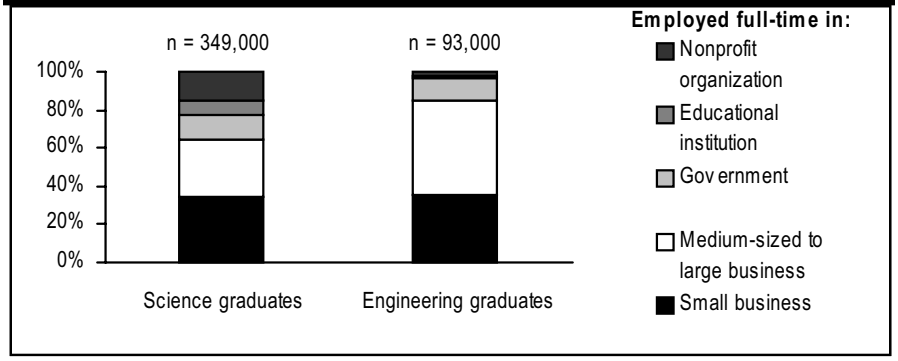
[1]These data are from the 1995 National Survey of Recent College Graduates, a survey sponsored by the National Science Foundation's Division of Science Resources Studies. For more information about the survey's design, implementation, and results, see the *1995 National Survey of Recent College Graduates Methodology Report* on the SESTAT Web page <<http://sestat.nsf.gov>>.

[2]These are defined as firms with 500 or more employees.

Figure 1. Employment sector of recent S&E bachelor's degree recipients in full-time jobs as of April 1995



NOTES: The survey included recent college graduates who had received their degrees between July 1, 1992 and June 30, 1994. The graduates were asked questions regarding their employment status on April 15,1995. Full-time employment is defined as 35 hours per week or more; full-time students are excluded. Medium-sized to large businesses are defined as for-profit firms with 500 or more employees. Small businesses are for-profit firms with less than 500 employees and self-employed individuals.

SOURCE: National Science Foundation/Division of Science Resources Studies, National Survey of Recent College Graduates: 1995, special tabulations.

In 1991, firms with fewer than 500 employees accounted for 25 percent of the jobs in high-tech industries (BLS 1994). And more recent studies indicate that small business will likely lead medium to large business in future employment growth, especially in technology-intensive industries. For instance, the employment of full-time-equivalent research and development (R&D) scientists and engineers rose almost twice as fast between 1995 and 1996 at small companies as at larger ones—18 percent versus 10 percent—according to a 1997 national survey of R&D-performing firms (NSF 1998). Although the same survey projected that employment would grow somewhat slower in 1997, small businesses were expected to continue to expand their employment of R&D scientists and engineers faster than larger businesses. Another study of hiring at small[3] emerging high-technology companies found employment rising by nearly 5 percent from August 1996 to August 1997, resulting in 118,000 net new jobs (CorpTech 1997). That study also projected job growth over the upcoming year (1998) of nearly 9 percent at technology companies with under 500 employees.

Many of the new technologies and industries that are very much a part of U.S. economic growth are closely identified with small business. They also tend to employ large numbers of scientists and engineers. (See box, "In Which Technologies Are Small Businesses Especially Active?") Biotechnol-

[3]In this study, "small" was defined as firms with fewer than 1,000 employees.

Table 1. Employment sector of recent S&E bachelor's degree recipients in full-time jobs as of April 1995, by selected characteristics

Characteristic	Total number employed full time	Industry				Nonprofit organization		Educational institution		Government	
		Medium-sized to large busines		Small business							
		Per-cent	Stan-dard error	Per-cent	Stan-dard error	Per-cent	Stan-dard error	Per-cent	Stan-dard error	Per-cent	Stan-dard error
Total, all S&E graduates	442,000	35	0.80	34	0.73	7	0.41	13	0.61	12	0.47
Broad field											
All sciences	349,000	31	0.90	34	0.88	8	0.51	16	0.73	12	0.57
All engineering	93,000	50	1.40	35	1.41	1	0.28	2	0.29	12	0.76
Degree field											
Computer and mathematical sciences	54,000	46	2.15	30	1.56	2	0.53	15	1.46	7	1.19
Life and related sciences	58,000	27	2.24	38	2.00	4	0.89	22	1.98	10	1.45
Physical and related sciences	17,000	30	2.30	39	2.67	2	0.68	15	1.63	15	1.80
Social and related sciences	221,000	28	1.19	33	1.27	11	0.82	14	0.99	13	0.72
Engineering	93,000	50	1.40	35	1.41	1	0.28	2	0.29	12	0.76
Sex											
Male	251,000	38	0.95	37	0.79	4	0.38	9	0.56	12	0.59
Female	191,000	31	1.09	29	1.27	11	0.85	18	1.08	11	0.72
Race/ethnicity											
White, non-Hispanic	360,000	35	0.89	36	0.82	6	0.46	12	0.64	11	0.54
Black, non-Hispanic	25,000	34	2.40	19	2.50	9	1.60	19	2.57	20	1.92
Hispanic	23,000	32	2.85	25	1.83	10	1.91	19	2.43	15	1.87
Other race/ethnicity	33,000	40	2.67	32	2.53	6	1.26	12	2.67	10	1.69

NOTES: Details may not add to totals and percents may not total to 100 because of rounding. The survey included recent college graduates who had received their degree between July 1, 1992 and June 30, 1994. The graduates were asked questions regarding their employment status on April 15, 1995. Full-time employment is defined as 35 hours per week or more; full-time students are excluded. Medium-sized to large businesses are defined as for-profit firms with 500 or more employees. Small businesses are for-profit firms with less than 500 employees and self-employed individuals.

SOURCE: National Science Foundation/Division of Science Resources Studies, National Survey of Recent College Graduate 1995, special tabulations.

ogy and computer software are good examples of industries built around new technologies that were often first commercialized by small business.[4] Small businesses may have certain advantages over large businesses in commercial environments characterized by fast-moving technologies and rapidly changing consumer needs. A keen receptivity to new product ideas found outside their own operations characterizes this efficiency (Hanson 1991). More flexible operating procedures allow small businesses to change research directions more quickly than larger businesses—providing yet another advantage in

[4]The role of small business as a commercializer of new technologies is somewhat unique to the United States. See Mowery and Rosenberg (1993).

today's marketplace (Wallsten 1998). These attributes combine to make small business a key sector to watch as new technologies are developed, adopted, and diffused.

In Which Technology Areas are Small Businesses Especially Active?

The CorpTech database of small business entities identifies each company's primary business activity by technology area. It includes many new startups and private companies missed by other databases and is one of the most current sources of information on small, newly formed companies active in high-tech fields. In the major technology areas covered in its database, CorpTech estimates that it includes 99 percent of companies employing more than 1,000 employees, 75 percent of companies employing 250 to 1,000 employees, and 65 percent of companies with fewer than 250 employees. The version of the database used here (Rev. 12.3 1997) includes over 35,000 independently managed companies. These data are used to identify trends since 1960 in U.S. high-tech business startups by technology area (table 2).

More than half of all high-tech companies included in the database and operating in 1997 were formed after 1979. (Company mergers and acquisitions may affect these trends.) The proportion is even higher—about 70 percent—for computer-related companies (which include both computer hardware and software companies) and for biotechnology companies.

Table 2. United States high-tech business formations, by technology area

Period formed	All high-tech fields	Automation	Biotechnology	Computer hardware	Advanced materials	Photonics & optics	Software	Electronic components	Telecommunications	Other fields [a]
Total, since 1960....	31,819	2,155	812	3,003	1,155	944	8,020	3,292	2,240	10,198
1980-94.....	18,529	1,041	610	2,090	527	507	5,506	1,524	1,375	5,349
1980-84.....	7,478	487	195	804	213	201	2,274	669	416	2,219
1985-89.....	6,978	383	236	812	211	187	2,014	577	483	2,075
1990-94.....	4,073	171	179	474	103	119	1,218	278	476	1,055
1995-June 97.....	912	27	11	89	24	11	300	46	217	187

[a]Other fields are chemicals, defense-related, energy, environmental, manufacturing equipment, medical, pharmaceuticals, test and measurement, and transportation.

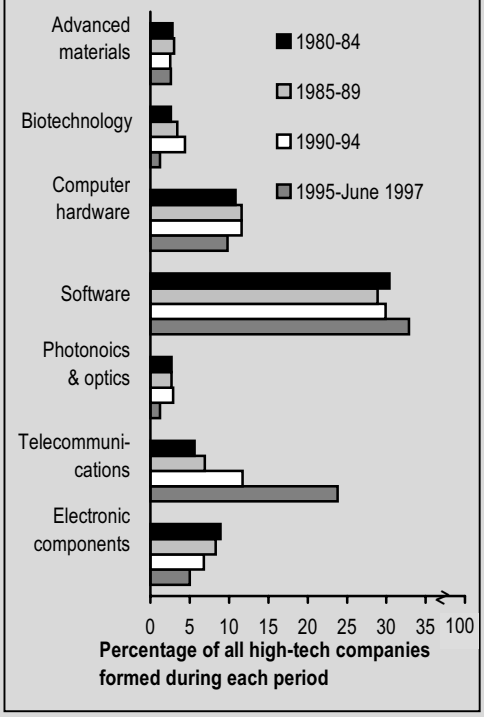
NOTES: Data reflect the number of companies formed since 1960 that were still in business as of June 1997. Company mergers and acquisitions will tend to understate the data shown in this table.

SOURCE: CorpTech database Rev. 12.3 (Woburn, MA: Corporate Technology Information Services, Inc.), special tabulations, July 1997.

From a technological standpoint, the 1980s were the decade of the computer's rapid integration into the U.S. workplace. The 1990s will likely be known as the decade in which the computer completely revolutionized the ways in which we work, learn, and play. Trends in new company formation since 1980 reflect this revolution. According to CorpTech's database, about 40 percent of the new high-tech businesses formed since 1980 were computer-related companies. Among these, software companies accounted for the largest number.

The number of new software companies stands out not just in the computer-related category but also when compared with all other technology fields (figure 2). Software development and/or servicing is the primary business of 30 percent of the more than 18,000 existing high-tech companies formed since 1980. Other technology fields that showed higher than average new company formations in the first half of the 1990s are companies in the telecommunications, photonics, and biotechnology fields. Lately (from 1995 to June 1997), the relative growth in new telecommunications-related companies has eclipsed that for software companies.

Figure 2. United States high-tech business formations, by technology area



SOURCE: CorpTech database Rev. 12.3 (Woburn,MA: Corporate Technology Information Services, Inc.), special tabulations, July 1997.

How do Salaries of Recent Grads Employed by Small Business Compare With Those in Other Sectors?

The median annual salaries paid to recent S&E baccalaureate graduates employed by medium-sized to large firms generally exceeded those paid by small firms.[5] This held true for each of the major degree fields examined. The highest paid recent graduates in small firms were those with bachelor's degrees in engineering; the next highest paid had degrees in computer and mathematical sciences or the physical sciences. Graduates with the lowest median annual salaries working in small firms were those with degrees in life and related sciences. In medium-sized to large firms, the lowest salaries went to those with bachelor's degrees in the social sciences (figure 3 and table 3).

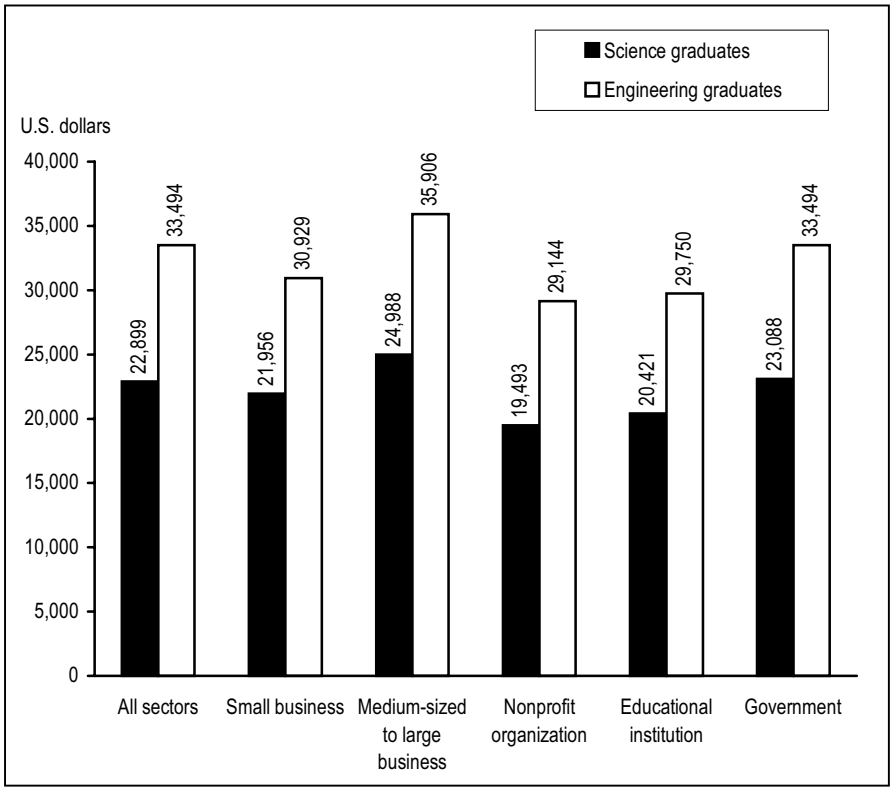
Does Firm Size Affect the Likelihood That S&E Grads Will Find Jobs Closely Related to Their Degree Fields?

In general, there do not appear to be significant differences by industrial employer size in the proportion of S&E grads who describe their jobs as being closely related to their degrees (table 4). The one exception to this conclusion is in the life sciences. Graduates with bachelor's degrees in life and related sciences who are working in industry are more likely to be in a job closely related to their college training if they are employed by a small business. The emergence and promise of new biotechnologies may have provided additional job opportunities for these graduates.

Opportunities for employment related to S&E degree vary by sector of employment and degree field. About half (between 49 and 53 percent) of those with degrees in engineering working in industry, in government, and at educational institutions described their jobs as closely related to their degrees. Only about 31 percent of engineering degree recipients working in the nonprofit sector reported working in jobs closely related to their degrees. Responses to the question by recent graduates with bachelor's degrees in science varied by field, although educational institutions generally offered more opportunities to work in jobs related to degree field (table 4).

[5]It is important to note that the salaries paid to scientists and engineers as a group are heavily affected by the mix of scientists and engineers working in each sector of employment.

Figure 3. Median annual salaries paid to recent S&E bachelor's degree recipients in full-time jobs as of April 1995



NOTES: The survey included recent college graduates who had received their degrees between July 1, 1992 and June 30, 1994. The graduates were asked questions regarding their employment status on April 15, 1995. Full-time employment is defined as 35 hours per week or more; full-time students are excluded. Medium-sized to large businesses are defined as for-profit firms with 500 or more employees. Small businesses are for-profit firms with less than 500 employees and self-employed individuals.

SOURCE: National Science Foundation/Division of Science Resources Studies, National Survey of Recent College Graduates: 1995, special tabulations.

Table 3. Median annual salaries paid to recent S&E bachelor's degree recipients in full-time jobs as of April 1995, by employment sector and other characteristics of the graduates

Characteristic	Total number employed full time	All sectors		Industry				Nonprofit organization		Educational institution		Government	
				Medium-sized to large business		Small business							
		Median salary	Standard error	Median salary	Standard error	Median salary	Standard error	Median salary	Standard error	Median salary	Standard error	Median salary	Standard error
Total, all S&E graduates	442,000	$24,968	247	$29,923	382	$24,394	279	$19,616	641	$20,489	487	$24,493	257
Broad field													
All sciences	349,000	22,899	249	24,988	241	21,956	447	19,493	682	20,421	354	23,088	480
All engineering	93,000	33,494	227	35,906	246	30,929	483	29,144	2,782	25,272	1,867	29,750	112
Degree field													
Computer & mathematical sciences	54,000	29,832	385	32,102	573	27,990	831	25,015	3,598	23,085	675	28,448	1,929
Life and related sciences	58,000	21,768	637	24,022	1,035	19,925	762	15,973	1,816	20,845	745	22,093	1,093
Physical and related sciences	17,000	24,965	605	28,859	962	23,992	685	21,591	4,521	22,046	978	24,829	1,224
Social and related sciences	221,000	21,046	266	22,941	437	20,918	505	19,095	703	19,866	406	22,932	531
Engineering	93,000	33,494	227	35,906	246	30,929	483	29,144	2,782	25,272	1,867	29,750	112
Sex													
Male	251,000	26,999	369	31,398	564	25,926	480	20,234	1,474	20,865	513	24,993	283
Female	191,000	21,907	255	24,982	507	20,631	508	19,192	719	19,998	285	21,987	457
Race/ethnicity													
White, non-Hispanic	360,000	24,495	255	29,400	504	23,966	292	18,668	612	19,986	196	24,379	297
Black, non-Hispanic	25,000	22,898	448	26,531	1,119	22,600	1,019	20,518	620	19,717	884	22,490	922
Hispanic	23,000	24,977	695	28,241	1,521	25,115	1,101	22,025	1,300	21,717	1,194	27,838	1,233
Other	33,000	28,882	571	32,669	1,207	25,533	1,011	21,571	2,236	29,027	1,980	29,247	2,391

NOTES: The survey included recent college graduates who had received their degrees between July 1, 1992 and June 30, 1994. The graduates were asked questions regarding their employment status on April, 15, 1995. Full-time employment is defined as 35 hours per week or more; full-time students are excluded. Medium-sized to large businesses are defined as for-profit firms with 500 or more employees. Small businesses are for-profit firms with less than 500 employees and self-employed individuals.

SOURCE: National Science Foundation/Division of Science Resources Studies, National Survey of Recent College Graduates: 1995, special tabulations.

Table 4. Extent to which full-time jobs held by recent S&E bachelor's degree recipients are related to their degrees, by employment sector and degree field as of April 1995

Degree field	Industry		Non-profit organization	Educational institution	Government
	Medium-sized to large business	Small business			
	[percentages]				
Sciences					
Job closely related to degree	26	27	45	53	42
Job somewhat related to degree	28	32	36	29	34
Job not related to degree	46	41	19	18	24
Computer and mathematical sciences					
Job closely related to degree	59	58	70	81	49
Job somewhat related to degree	28	22	8	14	34
Job not related to degree	13	20	22	5	17
Life and related sciences					
Job closely related to degree	28	40	41	58	43
Job somewhat related to degree	33	26	29	27	37
Job not related to degree	39	34	30	15	20
Physical and related sciences					
Job closely related to degree	41	40	9	60	47
Job somewhat related to degree	31	0	49	28	28
Job not related to degree	28	33	43	12	25
Social and related sciences					
Job closely related to degree	13	15	46	44	40
Job somewhat related to degree	33	31	38	34	34
Job not related to degree	54	55	17	23	26
Engineering					
Job closely related to degree	53	50	31	53	49
Job somewhat related to degree	38	36	42	29	38
Job not related to degree	10	14	27	17	13

NOTES: The survey included recent college graduates who had received their degree between July 1, 1992 and June 30, 1994. The graduates were asked questions regarding their employment status on April 15, 1995. Full-time employment is defined as 35 hours per week or more; full-time students are excluded. Medium-sized to large businesses are defined as for-profit firms with 500 or more employees. Small businesses are for-profit firms with less than 500 employees and self-employed individuals.

SOURCE: National Science Foundation/Division of Science Resources Studies, National Survey of Recent College Graduates: 1995, special tabulations.

Are Women and Minorities Finding Employment in Small Business?

Women with S&E bachelor's degrees are less likely than men to be employed by industry, both in small or medium-sized to large businesses. Women are far more likely to work for nonprofit organizations and educational institutions—sectors where salaries are generally lower for all employees (table 1 and figure 3).

Black and Hispanic bachelor's degree recipients were significantly less likely to work in small businesses (19 and 25 percent, respectively) than white graduates (36 percent).[6] Black and Hispanic S&E graduates were employed by larger firms in roughly equal proportion to whites. Data on the employment of Asian S&E bachelor's degree recipients by small business are too sparse to allow any conclusions to be drawn.

Conclusion

Data presented in this report highlight the important role played by small business as an employer of recent graduates in science and engineering. As a group, small businesses hire as many recent S&E graduates as do larger ones, and also as many as all other sectors of the U.S. economy combined. Small businesses are also shown to be closely identified with many of the technical areas considered important to future economic growth. The rapid formation of new small companies in biotechnology, telecommunications, and computer-related technologies since 1980 underscores this connection. As the technology revolution gains momentum, it is likely that U.S. small businesses will continue to play an important role in the years to come as an employer of graduates with baccalaureate degrees in science and engineering. More research is needed to better understand the S&E labor needs of small business and the implications, if any, for the U.S. educational enterprise.

[6] These differences may reflect choices in degree field.